MODEL OF TECHNOPRENEURSHIP DEVELOPMENT IN SEPULUH NOPEMBER INSTITUTE OF TECHNOLOGY INDUSTRIAL INCUBATOR

Tiara Erissa Devina[1), Dr.Ir.Bambang Syairudin, MT.[2) and Dr.Eng. Erwin Widodo, ST.,M.Eng[3)

Master's Program in Industrial Engineering, Institute Teknologi Sepuluh Nopember
Jl. Raya ITS, Surabaya, 60111, Indonesia
email: [1)tiaraedevina@gmail.com, [2)bambangsy@its.ac.id, [3)widodo@ie.its.ac.id

ABSTRACTS

Technopreneurship is a synergy of strong ability in mastering the technology and thorough understanding of the concept of entrepreneurship. There is a unit where technology prospective can develop ideas and innovations that will be implemented namely Industrial Incubator Center. ITS Industrial Incubator has 45 SME tenants who are divided into several areas have lower levels of spinoff companies, fluctuating tenats income indicate a incubator management problem. This study aims to bring up alternatives for developing technopreneurship strategies to achieve success of ITS Industrial Incubator with primary indicator of increased spinoff company and increase revenue incubator. System dynamic is used in the completion of this study, because of interactions complexity between variables and system behavior. There are 4 main model described in this study, commercialization, population of the company, human resources and revenues. Based on the simulation results of fourteen scenarios, it can be shown that the scenario has significant value to the purpose of the research is to increase the proportion of potential research allocations derived from PKM, increase spinoff company share profit and increase company venture capital provided by ITS Industrial Incubator against startups. The result is there is an increase of 3.8% on the number of company's spinoff from existing conditions and Industrial Incubator income also rise up to 120%.

Keywords: *technopreneurship, industrial incubator, strategies, system dynamics*

INTRODUCTION

In order to improve its economical condition, Indonesia must incerase the ratio of entrepreneurs population. Number of entrepreneurs in Indonesia reach 1,6% of the total population, where the number of entrepreneurs in Indonesia only amounted to approximately 4 million people (Depkop, 2015).

Over the time, the growth of entrepreneurship is also supported by the development of technology. A lot of young entrepreneurs started to use technology in their businesses. Merging these two things to build a new term in the world of entrepreneurship is called with technopreneurship. Technopreneurship word comes from the combination of technology and entrepreneurship skill (Depositario, 2011). Technopreneurship is the process in an organization that promotes innovation and continually find organization main problem, solve problem, and implement ways of solving problems in order to improve competitiveness in global markets (Okorie, 2014).

ISBN:

In Sepuluh Nopember Institute of Technology (ITS), there is a unit where technology prospective can develop ideas and innovations that will be implemented namely Industrial Incubator Center. ITS Industrial Incubator is a vehicle to help the young technopreneur who qualified to get facilities including: provision of office space, access to laboratories, training, professional network and help them gain access to financial source and markets until it succeeds to be an independent and competitive technopreneur (Jumayla, 2014).

There are 45 SMEs are nurtured in ITS Industrial Incubator which consists of 10 processing SMEs, 20 ICT SMEs, 9 creative industry SMEs, and 6 handicraft SMEs. Among the 45 SMEs, there are only 31 SMEs who graduated from incubator program and 3 of them categorize as spinoff company. Low graduation rates above, indicated that there is a problem regarding to ITS Industrial Incubator management.

From the results of in-depth interviews with experts from ITS Industrial Incubator still do not have program that can support its successfullness. Incubator program that have been run by ITS Industrial Incubator also did not have a proper strategy, so the success rate of SME tenants is still very low.

Based on research background above, researcher proposed a model of technopreneurship development in ITS Industrial Incubator with system dynamic approach. In this paper, a system dynamic model is used to explain about the behaviour of the system with the strategy on the technopreneurship development in Industrial Incubator. This research will identified the variables that influence the development of technopreneur which will affect the success of ITS Industrial Incubator.

MODEL CONSTRUCTION

System dynamics modelling (SDM) enables complex interactions between system components to be evaluated through exploration of how stocks and flows (also called rates, as represented by the differential equations which define how the level of a stock varies over time) connect to form a system (Chapman, 2016).

In the following sub section, we will outline how system dynamic model was constructed and tested for technopreneurship model, focusing on the (i) System description, (ii) design of stock and flow diagram, (iii) model verification and validation, and (iv) strategy scenario.

SYSTEM DESCRIPTION

The depiction of the system aims to understand the mechanisms involved in the system. It is intended to recognize the relationship between the need statement and the problem statement in order to solve existing problems. In this study, the depiction of the system used is Input-output Diagram and Causal Loop Diagram. The system that being modeled is ITS Industrial Incubator. Input-Output diagram of ITS Industrial Incubator system can be shown in Figure.1.

The input elements are obtained from analysis about technopreneurship in ITS Industrial Incubator above.

Output

The output of the system consists of desirable and undesirable output. Undesirable output is unavoidable and is usually a negative impact on system performance. The expected output are higher revenue of industrial incubator, higher number of spinoff company, adequate number of human resource, high level of research commercialization. The unexpected output is all the opposite of the expected output.

ISBN:

Input

Input from the system also categorized into two, namely controllable and uncontrollable inputs. In addition, there are also environmental inputs. In the diagram above, the environmental inputs are government regulation and entrepreneurship climate. The controllable inputs are technology availability and student entity. The uncontrollable inputs are laboratpry facilities, technology skill, service provided by Incubator, and mentor availability.

Control

Undesirable output have to served as a feedback through control management to turn inputs into expected outputs and anticipate undesirable output.

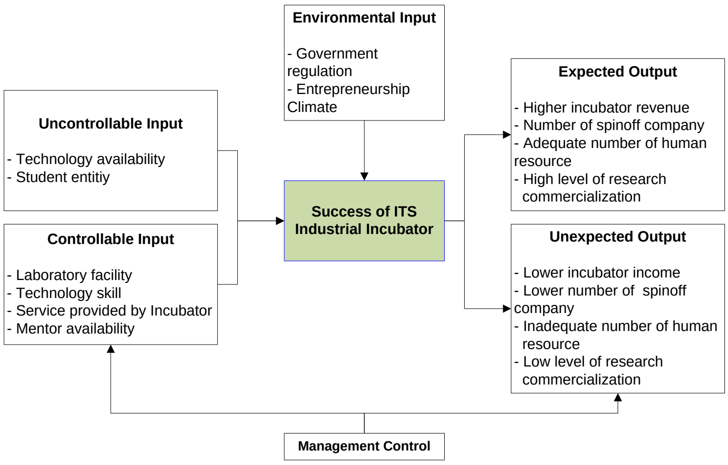

Figure 1. Input-Output Diagram

Causal loop diagram is used to show the main variables in the system. Causal loop diagram also can show cause and effect relationship between variables. The relationship will depicts with arrow symbol. Arrow with positive symbol indicate a proportional relationship, and adding the value of these variables will cause value added to the variable influenced. Otherwise, arrow with negative symbol indicates an inverse relationship, and adding the value to the variable will cause a reduction to the value of the variables influenced. Causal loop diagram of ITS Industrial Incubator showed in Figure 2 below.

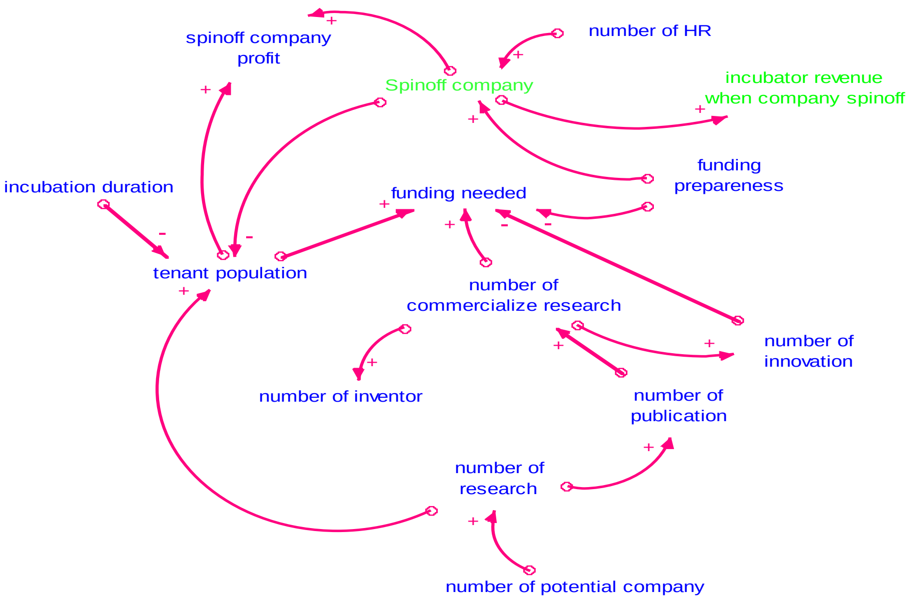

Figure 2. Causal Loop Diagram of ITS Industrial Incubator

ISBN:

Causal loop in Figure 2. shows 2 parameters of ITS Industrial Incubator successfulnes, number of spinoff company and incubator revenue. Tenant population is the important variable for spinoff company, which influenced by number of potential company, specialization number in incubator and tenant duration. The important factor for incubator revenue is the number of spinoff company itself, and also number of sales.

DESIGN OF STOCK AND FLOW DIAGRAM

Stock and flow diagrams are based on causal loop diagram. The purpose of making stock and flow diagram is to describe the interaction between variables in accordance with the logic of the structure on which the software is used. Modelling the interaction of variabels in stock and flow diagrams produced some sub-model that interrelated. Design of stock and flow diagram also consider the purpose of research where it can describe the influence of strategy instrument on the observation system. There are 4 stock and flow diagrams model that can be shown in Figure 3.

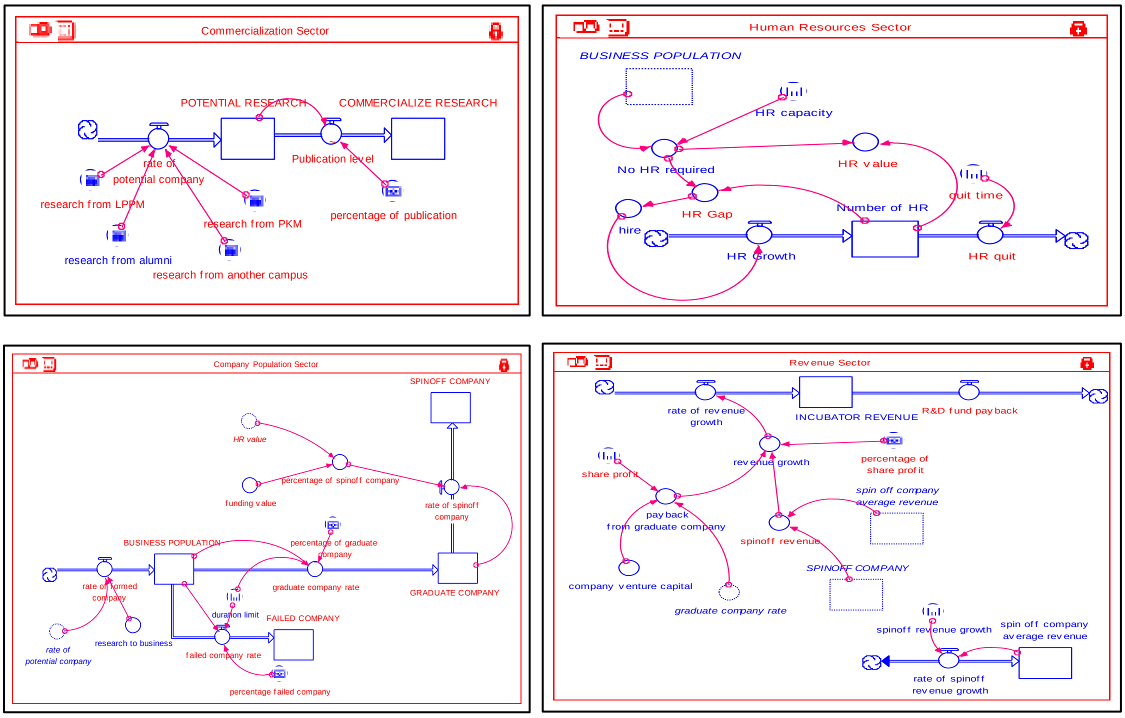

Figure 3. Design of Stock and Flow Diagram for Industrial Incubator Successfulness

MODEL VERIFICATION AND VALIDATION

Verification of the model is a stage to determine whether the simulation model represents a conceptual model as appropriate (Harrell et al, 2003). In this study, model verification is done by checking errors in the models and make sure that the model function in accordance with the logic of the system of observation. In addition, verification should also be conducted to examine formulations (equations), the model and checking unit (unit) variables of the model. If there are errors in the models it can be concluded that the model has been verified. Based on the results of model simulations, it does not contain any errors or formulation unit.

Validation is a stage in evaluating whether the models are representative with a real condition of the system. Validation models performed to determine that the conceptual model has to represent or reflect the real system appropriately and meet overall modelling purposes (Harrell et al., 2003). There are 5 phase to examine the model validation.

ISBN:

Structural Model Test

Structural test model aim to see whether the structure of the models built are appropriate with the structure of the real system. Any factor that affects other factors that should be reflected in the model. This test is done by the expert who are familiar with the concepts and systems which in this case is the condition of ITS Industrial Incubator. Technopreneurship development system model to improve the success of ITS Industrial Incubator has been created with the formulation and the unit has been received by the expert, then the model is valid qualitatively.

Boundary Adequacy Test

Limitation of the model must be fit for purpose designed models. The purpose of making this model is to create a development model to achieve success of technology Industrial Incubator. Restrictions on models already done when the model is made, by testing a variable that has been incorporated into the model. In this case, if a variable has no significant effect on the model designation, then the variable is not necessary to put in this model.

Model Parameter Test

Model parameter test is done by looking at two variables are interrelated, and compare the results with the actual logic simulation results. In this model, used a variable number of potential variables and variable number of commercialize companies, in which both of these variables has a positive causal relationship.

Extreme Condition Test

Extreme condition test aimed to testing the ability of the model to the extreme conditions of variable values changed significantly thus contributing as an evaluation tool. This test can be done by entering the largest and smallest extreme value.

Replication Model Test

Replication model test is performed to determined whether the model is behaving the same as the real conditions or representative. This test can compare simulation data with actual data using the model (Barlas, 1996).

STRATEGY SCENARIO

The simulation was performed based scenarios designed. The scenario built according to the conditions that allow it to be controlled by stakeholders whose handling policy ITS Industrial Incubator. Alternative strategies are made is an effort to increase the number of spinoff companies and increase revenue of ITS Industrial Incubator. Explanation of the key parameters that have been defined and are the basis for determining the corrective scenario is as follows:

1. Allocation of student research that went into incubator
2. Increase the share of profit spinoff company
3. Increase the level of provision of venture capital to companies
4. Lower capacity SDM (mentor)

From the four strategy scenario above, there will be made combination of scenario so we will get the best results that give the largest contribution to ITS industrial incubator.

RESULT AND DISCUSSION

Based on the simulation result of scenario combination above, there are 14 combination of scenario which are important for selecting the best result to give the largest contribution for ITS Industrial Incubator. From 14 scenario combination that have been

ISBN:

made, we chose 4 best scenario that have the greatest contribution to the main purpose of this research.

Table 2. Simulation Result of First Scenario Combination

Scenario 1 and 2						
year	**Research commercialization**	**Graduated company**	**Spinoff company**	**No. HR**	**Spinoff company revenue**	**Incubator revenue**
0	0	31	2	5	520	0
1	3	68	3	9	793.11	9.2
2	10	104	5	9	1,344.08	23.86
3	20	138	9	9	2,460.01	49.54
4	36	170	15	8	4,168.94	97.54
5	56	200.00	22	8	6,217.24	179.62
6	76	228.00	30	8	8,620.57	302.57
7	96	255.00	39	7	11,395.14	473.58
8	116	281.00	48	9	14,260.57	699.98
9	136	306.00	59	9	17,823.29	983.79
10	156	331.00	71	9	21,808.93	1,338.96
Total	**705**	**2112**	**303**	**90**	**89411.88**	**4158.64**
Average	**64**	**192**	**27**	**8**	**8128.353**	**378.0582**

From the simulation results the first scenario above, the positive results obtained in the form of increase in the number of spinoff companies in the amount of 3.8% or there is the addition first spinoff company that is from 26 companies to 27 companies. While the increase in revenue by 115% Industrial Incubator, where there is an increasing amount of revenue which the existing condition on the amount of income to be 175 million to 378 million.

Table 3. Simulation Result of Second Scenario Combination

Scenario 2 and 3						
year	**Research commercialization**	**Graduated company**	**Spinoff company**	**No. HR**	**Spinoff company revenue**	**Incubator revenue**
0	0	31	2	5	520	0
1	3	68	3	9	793.11	11.1
2	9	104	5	9	1,344.08	27.66
3	19	138	9	9	2,460.01	55.24
4	35	170	15	8	4,168.94	105.14
5	55	199.00	22	8	6,217.24	188.92
6	75	226.00	30	8	8,620.57	313.52
7	95	250.00	39	7	11,395.14	485.88
8	115	272.00	48	9	14,260.57	713.43
9	135	294.00	58	10	17,521.20	998.44
10	155	317.00	69	10	21,194.60	1,348.97
Total	**696**	**2069**	**300**	**92**	**88495.46**	**4248.3**
Average	**63**	**188**	**27**	**8**	**8045.042**	**386.2091**

From the simulation results the first scenario above, the positive results obtained in the form of increase in the number of spinoff companies in the amount of 3.8% or there is the addition first spinoff company that is from 26 companies to 27 companies. While the increase in revenue by 119% Industrial Incubator, where there is an increasing amount of revenue which the existing condition on the amount of income to be 175 million to 386 million.

Table 4. Simulation Result of Third Scenario Combination

Scenario 1,2 and 3						
year	**Research commercialization**	**Graduated company**	**Spinoff company**	**No. HR**	**Spinoff company revenue**	**Incubator revenue**
0	0	31	2	5	520	0
1	3	68	3	9	793.11	11.1
2	10	104	5	9	1,344.08	27.66
3	20	138	9	9	2,460.01	55.24
4	36	170	15	8	4,168.94	105.14
5	56	200.00	22	8	6,217.24	189.07
6	76	228.00	30	8	8,620.57	313.82
7	96	255.00	39	7	11,395.14	486.63

ISBN:

8	116	281.00	48	9	14,260.57	714.78
9	136	306.00	59	9	17,823.29	1,000.39
10	156	331.00	71	9	21,808.93	1,357.41
Total	**705**	**2112**	**303**	**90**	**89411.88**	**4261.24**
Average	**64**	**192**	**27**	**8**	**8128.353**	**387.3855**

From the simulation results the first scenario above, the positive results obtained in the form of increase in the number of spinoff companies in the amount of 3.8% or there is the addition first spinoff company that is from 26 companies to 27 companies. While the increase in revenue by 120% Industrial Incubator, where there is an increasing amount of revenue which the existing condition on the amount of income to be 175 million to 387 million.

Table 5. Simulation Result of Fourth Scenario Combination

Skenario 1,2,3 dan 4						
Year	**Research commercialization**	**Graduated company**	**Spinoff company**	**No. HR**	**Spinoff company revenue**	**Incubator revenue**
0	0	31	2	5	520	0
1	3	69	2	11	528.74	11.1
2	10	105	4	11	1,075.26	22.37
3	20	139	8	11	2,186.67	44.58
4	36	171	14	10	3,891.01	89.01
5	56	201.00	21	10	5,934.63	167.38
6	76	229.00	29	10	8,333.22	286.48
7	96	256.00	38	10	11,102.96	453.54
8	116	281.00	48	11	14,260.57	675.85
9	136	306.00	59	12	17,823.29	961.46
10	156	331.00	71	11	21,808.93	1,318.48
Total	**705**	**2119**	**296**	**112**	**87465.28**	**4030.25**
Average	**64**	**192**	**26**	**10**	**7951.389**	**366.3864**

From the simulation results above the fourth scenario, the positive results obtained in the form of increased revenues 108% Industrial Incubator, where there is an increasing amount of revenue which the existing condition on the amount of income to be 175 million to 366 million. As for the number of spinoff companies that are in the same grade as the existing condition.

CONCLUSIONS AND RECOMMENDATIONS

This research has resulted in the model of technopreneurship development on ITS Industrial Incubator with dynamic system approach that has a major contribution of increased corporate spinoff and increase revenue of the Industrial Incubator. The system is described in a stock and flow model of which has four submodels, namely submodel commercialization, company submodel population, submodel human resources, and submodel revenue.

From the simulation results of fourteen alternative scenarios finally obtained four alternative scenarios that have significant value to the purpose of research which simulated the third scenario, where the combination of the simulation is to increase the proportion of allocation of potential research derived from PKM, increasing the share profit of spinoff company and raise capital venture provided by ITS Industrial Incubator. The results obtained are the number of spinoff companies increased by 3% from the existing condition that is on the average 26 companies a year to 27 spinoff companies every year, as well as increased income earned ITS Industrial Incubator. Incubator revenue rose by up to 120%, of the average income of 175 million and eventually reach 387 million.

Some recommendations for future research: to define another success variable for industrial incubator model is requires, so the results obtained more comprehensive different strategy and models need to be developed more widely and made more general, so that research results can be used in the form of a policy strategy for the entire Industrial Incubator.

ISBN:

REFERENCES

Barlas, Y. (1996). Format aspect of model validity and validation in system dynamics. *System Dynamics Review,* pp.12(3): 183-210.

Depositario D. P. T., Aquino N. A., & Feliciano K.C. (2011). Entrepreneurial skill development needs of potential agri-based technopreneurs. *ISSAAS,* 17(1),pp. 106-120.

Jumayla, Sari. (2014). *Perancangan Instrumen Penilaian Tingkat Penilaian Tingkat Kemandirian UKM Tenant di Inkubator Industri ITS.* Penerbit ITS, Surabaya.

N. N., Okorie., D.Y. Kwa., S. O. O, Olusunle., A. O, Akinyanmi., I. M. Momoh. (2014). Technopreneurship: An Urgent Need in The Material World for Sustainability in Nigeria. *European Scientific Journal*, Vol.10(30), 1857-7881.

ISBN: